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SHOCK RESISTANT LUCITE GRADUATE

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Technicians making field measurements of water in rain gages, at infiltration plots, and in other related activities on the San Dimas Experimental Forest in southern California have found need for graduated cylinders more resistant to breakage than commercial glass graduates. This need became evident several years ago when the rainfall sampling network for the experimental forest was established. The network included several hundred non-recording rain gages. Reduction in the cost of such a large number of gages was effected by eliminating the inner brass tube used to magnify the gage catch 10-1, which is an essential part of the standard Weather Bureau type gage. In place of the brass tube, each field observer was provided with a laboratory type glass cylinder graduated in inches of rainfall. As time progressed, however, it was found that although the system was good, the breakage rate of glass cylinders was high, despite the use of protective cases of various types.

The situation was eventually remedied by making the cylinders of lucite, a clear plastic material that is relatively tough and easily reparable. Shock resistant graduates of this type might be adapted to many other uses where breakage of glass cylinders is a problem. The following description of materials and graduation procedure has been prepared for the guidance of those who wish to construct similar graduates.

Materials, Dimensions, and Accessories

The graduate illustrated in the accompanying photograph was designed for the measurement of rainfall caught in 8-inch diameter rain gages. It has a capacity of $2\frac{1}{2}$ inches of rain and is graduated in increments of 0.02 inch. It is 18 inches tall and $3\frac{1}{2}$ inches in outside diameter. The cylinder is commercial lucite tubing with 1/8-inch wall thickness and $3\frac{1}{4}$ inches inside diameter. The bottom is a disc of $\frac{1}{4}$-inch sheet lucite cemented to one end of the cylinder. Lugs of $\frac{1}{4}$-inch lucite, semicircular in shape and about $1\frac{1}{2}$- by 5/8-inch in size, are cemented to the outside of the cylinder at the top and the bottom. The lugs are drilled with $\frac{1}{4}$-inch holes through which a leather carrying thong may be attached.

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Construction Guides

Construction of the bottom disc and graduation of the cylinder are best accomplished through the use of a metal-turning lathe. The bottom disc, $3\frac{1}{2}$ inches in diameter, is cut out of the flat $\frac{1}{4}$-inch stock, which should be trimmed roughly circular so that it can be gripped by the lathe chuck. Next, a recess or tenon is turned to a scant $3\frac{1}{4}$ inches on the disc to make a snug fit in the cylinder. This cut is 5/32-inch wide, leaving a flange 3/32-inch thick and 1/8-inch wide that fits over the end of the cylinder and flush with the outside diameter. After the bottom disc has been turned, a wooden disc similar in form but about 3/4-inch thick should be made. This wooden disc will be used to support the cylinder at the tailstock during graduation, as shown in the photograph. The bottom disc is cemented to one end of the cylinder using a commercial cement suitable for lucite. Satisfactory cement can be made by dissolving lucite shavings in chloroform until the solution is slightly viscid.

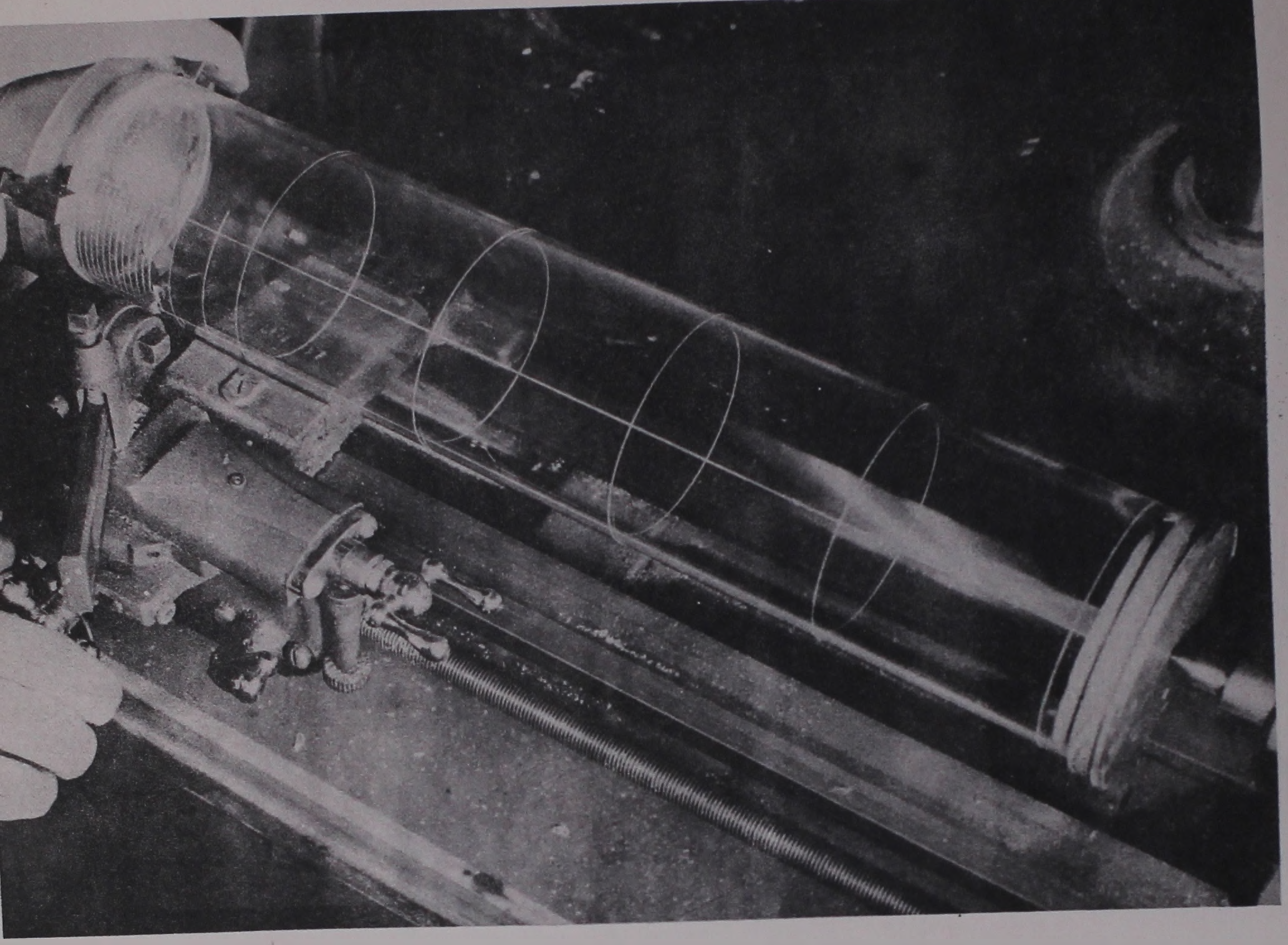
Graduation Procedure

The bottom end of the cylinder is gripped in a three-jaw chuck on the lathe headstock. The wooden disc is placed in the other end of the cylinder and centered at the tailstock. A thin, sharp-pointed cutter bit or a fine formed-threading tool mounted on the lathe carriage is used to scribe the graduations. Longitudinal lines can be scribed by locking the bull gear and running the lathe carriage along the bed with the hand feed. Transverse lines are scribed by hand-rotating the spindle.

In practice, first a line is scribed the length of the cylinder. The cylinder is removed from the lathe, set on a level surface and graduation points for .02, .10, .50, 1.00, 1.50, 2.00 and 2.50 inches are established along the scribed line by pouring in appropriate amounts of water--16.47 cubic centimeters of water are equivalent to 0.02 inches depth in an 8-inch rain gage. These points are marked with a scriber; then with dividers, the half-inch intervals are subdivided into tenth-inch intervals and these into the smallest intervals of .02 each.

The cylinder is replaced in the lathe, and the circular graduations are scribed by advancing the cutter bit to each point of calibration and rotating the cylinder by hand for the required length of line as shown in the photograph. The graduations are numbered by pressing hot metal numeral stamps into the lucite.

A lucite graduate of this size costs about $3.50 for material, the tubing costing $2.50 a lineal foot and the sheet material about $1\frac{1}{2}$ cents per square inch. The cylinders are very shock resistant but are not unbreakable. A fall on a rock or a concrete floor can crack the material or sometimes break it. If a bottle of cement is carried in the field, temporary repairs can usually be made by painting cracks with cement or cementing broken pieces in place.



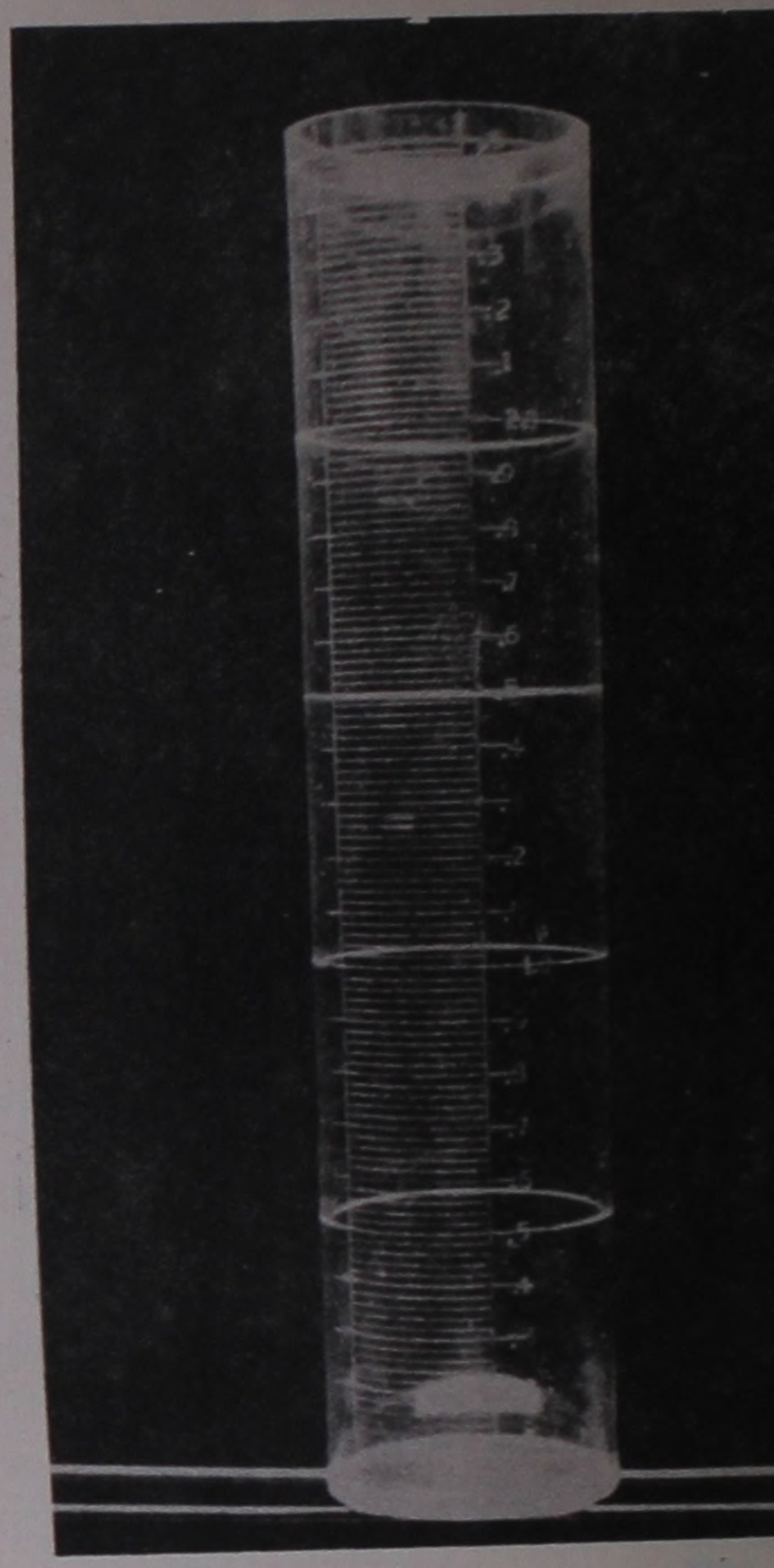


Figure 1.--(Right) Lucite cylinder calibrated for measurement of the rain catch of a standard 8-inch diameter rain gage. (Left) Graduation procedure, showing lucite cylinder chucked in lathe.